www.epa.gov/nrmrl

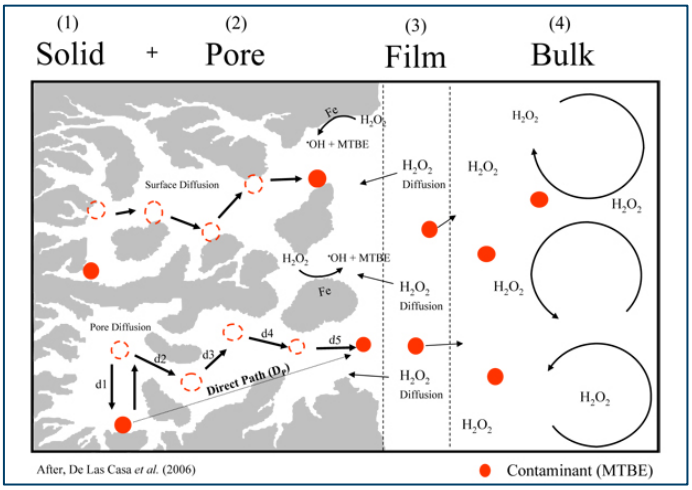
NRMRL
NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
GROUND WATER AND ECOSYSTEMS RESTORATION RESEARCH

Effects of Temperature and Acidic Pre-Treatment on Fenton-Driven Oxidation of MTBE-Spent Granular Activated Carbon

Abstract

The effects of temperature and acidic pre-treatment on Fenton-driven chemical oxidation of methyl tert-butyl ether (MTBE)-spent granular activated carbon (GAC) were investigated. Limiting factors in MTBE removal in GAC include the heterogeneous distribution of amended iron and slow intra-particle diffusive transport of MTBE and hydrogen peroxide (H_2O_2) into the "reactive zone."

Acid pre-treatment of GAC before iron amendment altered the surface chemistry of the GAC, lowered the pH point of zero charge, and resulted in greater penetration and more uniform distribution of iron in GAC. This led to a condition where iron, MTBE, and H_2O_2 co-existed over a larger volume of the GAC, contributing to greater MTBE oxidation and removal. H_2O_2 reaction and MTBE removal in GAC increased with temperature. Modeling H_2O_2 transport and reaction in GAC indicated that H_2O_2 penetration was inversely proportional with temperature and tortuosity, and occurred over a larger fraction of the total volume of small GAC particles (0.3 milllimeters [mm] diameter) relative to large particles (1.2 mm diameter). Acidic pre-treatment of GAC, iron amendment, elevated reaction temperature, and use of small GAC particles are operational parameters that improve Fenton-driven oxidation of MTBE in GAC.



Schematic of the proposed mechanisms of (1) intra-particle MTBE mass transfer (desorption), (2) MTBE diffusive mass transport (pore + surface), intra-particle diffusive transport of H_2O_2, (3) MTBE diffusive transport outward through the quiescent film, H_2O_2 diffusive transport from the bulk solution through the quiescent film into the GAC pores, and (4) MTBE and H_2O_2 mixing in bulk solution. Fenton-driven regeneration of GAC involves the simultaneous occurrence of these mechanisms.

Products

Kan, E. and Huling, S.G. (2009). "Effects of Temperature and Acidic Pre-Treatment on Fenton-Driven Oxidation of MTBE-Spent Granular Activated Carbon." *Environmental Science and Technology*, 43, 5: 1493–1499.